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Examiners' Report
June 2013

GCSE Astronomy 5AS01 01

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June 2013

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Introduction

This is the third year that the new specification has been examined and the intended emphasis on planning and carrying out practical, observational Astronomy was continued. Interestingly, it was very evident that those candidates who had spent a considerable amount of time actually observing various aspects of the night sky during their study of Astronomy were able to write convincing answers. Items such as 1(b) (red filters on torches), 3(a) (Pegasus and Andromeda), 3(c) (naked-eye appearance of an open cluster), 5(a) and 5(b) (lunar phases), 6(a) (appearance of the Milky Way in the night sky) and 16(b) (times of culmination of stars) allowed candidates to demonstrate their awareness of this key part of the specification.

Candidates were also given the opportunity to apply their knowledge and understanding to unfamiliar situations and the examiners were pleased that questions 11 and 16, in which information had to be extracted from tables of data, were carried out with a pleasing amount of success. Furthermore, candidates were able to use their mathematical reasoning skills to give convincing answers to items such as 12(b) (pull of gravity on a comet), 15(a) (absorption of electromagnetic radiation by the Earth's atmosphere) and 20(b) (apparent magnitude of a star).

There was continued opportunity in 2013 for candidates to demonstrate their awareness of How Science Works in many items such as 2(b) (discoveries of Uranus and Pluto), 8(a) (how astronomers can test the possible origin of the Earth's water), 12(c) (the Giant Impact Hypothesis) and 15(c) (discovery of the Van Allen Belts).

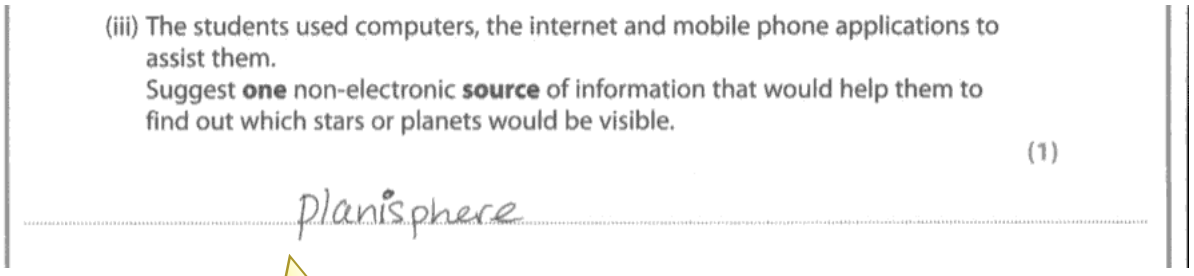
Although the paper contained some familiar themes, there was still an opportunity to examine novel topics such as the relative penetration of the Earth's atmosphere by different types of electromagnetic radiation, items 15(a) and 15(b), and 'alternative' models for the past evolution of the Universe, item 18(b).

The variety of question styles continued this year in the same vein as in recent years: objective questions, tasks requiring short explanations, completion of diagrams or using them to aid an explanation, mathematical calculation and/or reasoning and more open-ended tasks were all present. In line with previous examinations, there was a gradual increase in difficulty through the paper with relatively straightforward tasks on familiar topics at the start progressing to quite challenging questions on more complex material towards the end.

Question 1 (a) (iii)

Question 1 was generally answered well by most candidates who were keen to show their knowledge of the night sky.

In particular, responses to 1(a)(iii) were pleasing, with most candidates correctly choosing the planisphere as their source of information.



(iii) The students used computers, the internet and mobile phone applications to assist them.
Suggest **one** non-electronic **source** of information that would help them to find out which stars or planets would be visible.

(1)

planisphere

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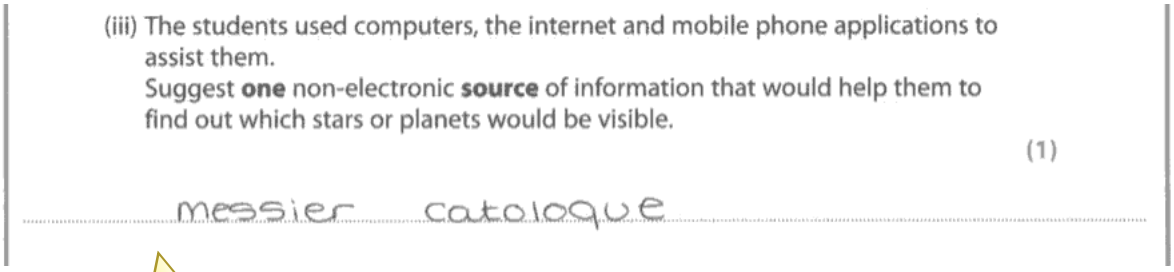
Examiner Comments

This candidate scores 1/1 for correctly giving the planisphere as the source of information.



(iii) The students used computers, the internet and mobile phone applications to assist them.
Suggest **one** non-electronic **source** of information that would help them to find out which stars or planets would be visible.

(1)

messier catalogue

ResultsPlus
Examiner Comments

This candidate seems unsure as to the contents of the Messier catalogue which does not give information on stars or planets (0/1).

Question 3 (a) (ii)

The location of the Andromeda Galaxy proved a hard task for many candidates, and responses varied considerably.

3 (a) Figure 2 shows parts of the constellations Pegasus and Andromeda.
Two stars, **P** and **Q**, are labelled.

Figure 2

(ii) On Figure 2, use the letter **X** to locate the position of the Andromeda Galaxy.

(1)

ResultsPlus
Examiner Comments

This candidate has incorrectly placed the Andromeda Galaxy in the middle of the Great Square of Pegasus (0/1).

ResultsPlus
Examiner Tip

Using 'pointer' stars to locate other important stars or nebulae is a key skill. The specification lists those pointer stars that could be examined, so make sure that you know them all.

3 (a) Figure 2 shows parts of the constellations Pegasus and Andromeda.
Two stars, **P** and **Q**, are labelled.

Figure 2

(ii) On Figure 2, use the letter **X** to locate the position of the Andromeda Galaxy.

(1)

ResultsPlus
Examiner Comments

This candidate has convinced the examiners that he or she knows the location of the Andromeda Galaxy (close to and to the right of the 'top' star) and scores 1/1.

Question 3 (b) (i)-(ii)

This question gave a variety of responses. Most candidates were able to draw the basic shape of Orion, but many included Aldebaran as part of the constellation. The location of The Pleiades proved quite difficult for many.

(b) Stars in Orion's Belt can be used to locate Aldebaran and The Pleiades, an open cluster of stars. Figure 3 shows the star Aldebaran.

Figure 3

(i) Sketch the constellation Orion on Figure 3.

(2)

(ii) Indicate the position of The Pleiades on Figure 3 (use the letter **P**).

(1)

ResultsPlus
Examiner Comments

The candidate has drawn Orion correctly, but the 3 stars in the 'belt' do not point to Aldebaran. The candidate has also drawn The Pleiades in the wrong location and scores 1/2 and 0/1.

(b) Stars in Orion's Belt can be used to locate Aldebaran and The Pleiades, an open cluster of stars. Figure 3 shows the star Aldebaran.

Figure 3

(i) Sketch the constellation Orion on Figure 3.

(2)

(ii) Indicate the position of The Pleiades on Figure 3 (use the letter **P**).

(1)

ResultsPlus
Examiner Comments

Orion has been drawn correctly, but the 3 stars in Orion's Belt do not point accurately enough to Aldebaran (1/2). The Pleiades is located correctly and scores 1/1.

ResultsPlus
Examiner Tip

The ability to draw listed constellations and use pointer stars to locate stars and nebulae is a key feature of the GCSE specification, so make sure that you can draw them all accurately.

Question 3 (c)

There was a vast range of descriptions of the naked-eye appearance of The Pleiades. The examiners were hoping that phrases such as 'faint and fuzzy' would be popular, as they were.

(c) Describe briefly the naked-eye appearance of an open cluster such as The Pleiades.

(1)

Bright with a blue-ish tint all bundled together

ResultsPlus
Examiner Comments

Although 'faint and fuzzy' did not feature in this response, the examiners were convinced that this was a correct description (1/1).

ResultsPlus
Examiner Tip

When answering a question such as this, convince the examiners that you know what you are talking about; avoid vague answers that could be describing almost anything.

(c) Describe briefly the naked-eye appearance of an open cluster such as The Pleiades.

optically

(1)

The stars look grouped together, but are actually thousands of miles apart.

(Total for Question 3 = 6 marks)

ResultsPlus
Examiner Comments

The examiners felt that this response was more of a description of the physical nature of an open cluster such as The Pleiades rather than its naked-eye appearance (0/1).

Question 4 (b)

Most candidates recalled that the Earth rotated through 1 degree in 4 minutes. Question 4 as a whole was answered very well.

(b) How many minutes does it take for the Earth to spin on its axis through 1 degree?

(1)

4 minutes

ResultsPlus
Examiner Comments

A correct response, worthy of 1/1.

Question 4 (d)

The examiners were pleased that most candidates knew the temperature of the Sun's photosphere either in Kelvin or degrees Celsius.

(d) What is the approximate temperature of the Sun's photosphere? Include the unit. (1)

5600 K

ResultsPlus
Examiner Comments

A correct response that scores 1/1.

ResultsPlus
Examiner Tip

This question, along with others in the examination paper, asks for the unit in addition to the numerical value. Make sure that you include the unit in this and similar questions - the unit is too-often omitted.

(d) What is the approximate temperature of the Sun's photosphere? Include the unit. (1)

2 million K

ResultsPlus
Examiner Comments

This candidate seems to have confused the temperature of the Sun's photosphere with that of the corona (0/1).

Question 4 (f)

Many candidates knew that the month of June gave the shortest shadows, but there was an interesting array of other responses that included February, August and November.

Question 5 (a) (i)

The majority of candidates knew that the Moon was in the gibbous phase. Some incorrect responses included half-full or first quarter, which are clearly both incorrect.

Question 5 (a) (ii)

Most candidates gave around 10 days as their correct response.

Question 5 (a) (iii)

The examiners were pleased that most candidates drew a waning gibbous Moon.

(iii) In the space below, sketch the phase of the Moon as it would appear 7 days later.

(1)

ResultsPlus
Examiner Comments

This is a rough sketch that seems to indicate a full Moon (0/1).

(iii) In the space below, sketch the phase of the Moon as it would appear 7 days later.

(1)

ResultsPlus
Examiner Comments

A pleasing sketch, clearly showing the gibbous phase of the Moon (1/1).

Question 5 (b)

The examiners were pleased that most candidates knew the full phase and copper/red appearance of the Moon during a total lunar eclipse.

Question 5 (c)

Many candidates correctly explained this in terms of the relative sizes of the Earth and Moon or their respective shadows. However, some candidates' incorrect responses referred to the orbital plane of the Moon or the tilt of the Earth's axis.

(c) Suggest why lunar eclipses can be observed more often than solar eclipses from a given latitude on Earth.

(1)

They can be observed more often because a lunar eclipse occures more often where as Solar eclipses are fairly rare and dont happen as much.

(Total for Question 5 = 6 marks)

ResultsPlus
Examiner Comments

The candidate seems to be repeating the question by stating that lunar eclipses occur more often than solar eclipses. The question is trying to find out whether the candidate knows the reason for this (0/1).

ResultsPlus
Examiner Tip

Ensure that you read the question carefully so that you understand what it is that you are being asked to do.

(c) Suggest why lunar eclipses can be observed more often than solar eclipses from a given latitude on Earth.

(1)

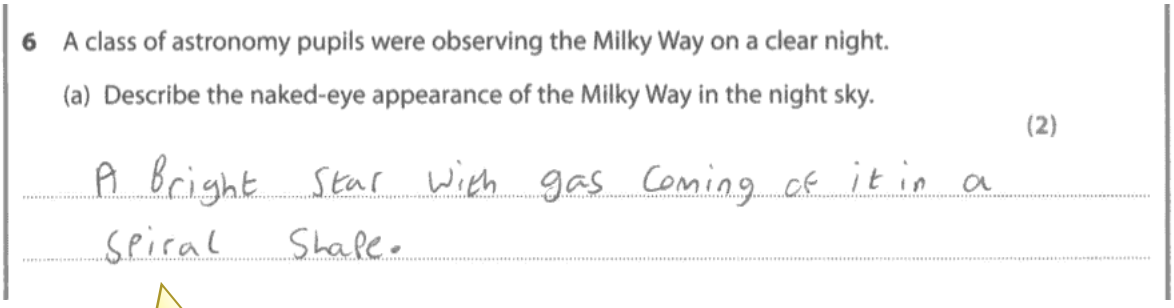
beacuse the earth's shadow is bigger then the moon.

ResultsPlus
Examiner Comments

This candidate convinced the examiners that it was the shadows that he or she was referring to and was awarded 1/1.

Question 6 (a)

Although many candidates may never have witnessed the splendour of the Milky Way in the night sky due to light pollution, it is a requirement of the specification and so they should be expected to describe its indistinct or pale nature stretching right across the sky. Unfortunately, many candidates misinterpreted the question and described its physical nature, mentioning spiral arms and nuclear bulge.



6 A class of astronomy pupils were observing the Milky Way on a clear night.

(a) Describe the naked-eye appearance of the Milky Way in the night sky.

(2)

A bright star with gas coming of it in a spiral shape.

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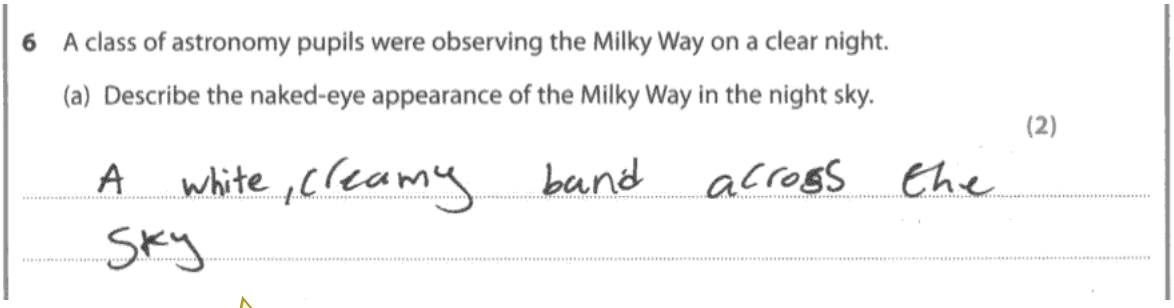
Examiner Comments

This was a description of the physical nature of the Milky Way rather than a description of its appearance in the night sky 0/2.

ResultsPlus
Examiner Tip

Read every word of the question carefully. This asks for the naked-eye appearance in the night sky and not what spiral galaxies look like.



6 A class of astronomy pupils were observing the Milky Way on a clear night.

(a) Describe the naked-eye appearance of the Milky Way in the night sky.

(2)

A white, creamy band across the sky

ResultsPlus
Examiner Comments

A convincing response: the candidate has indicated the 'creamy band' nature and described it as being 'across the sky' (2/2).

Question 6 (b)

Although many candidates could correctly give two sources of light pollution (e.g. street lights and security lights), they appeared to miss the important word 'different'. Two sets of lights were not deemed different enough and examiners were expecting that the full Moon or aurorae might feature more in candidates' responses. There were also several suggestions that cities or lamp posts were major sources of light pollution, which they are clearly not.

(b) Sometimes the Milky Way is faint or barely visible because of light pollution.
Suggest **two** different **sources** of light pollution.

(2)

1 Street lamps

2 House / building lights

ResultsPlus
Examiner Comments

Two types of lighting only scores 1/2 marks.

(b) Sometimes the Milky Way is faint or barely visible because of light pollution.
Suggest **two** different **sources** of light pollution.

(2)

1 Street - Light

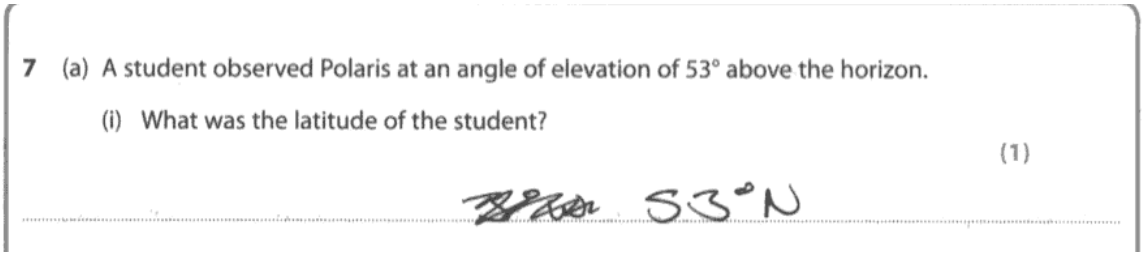
2 Moon (reflection from sun)

ResultsPlus
Examiner Comments

Two different sources of light pollution have been correctly identified (2/2).

Question 7 (a) (i)

Not only were the examiners expecting candidates to know that the elevation of Polaris was equal to an observer's latitude (53 degrees), they also required some indication of the northern hemisphere. Many candidates failed to include this important facet.


7 (a) A student observed Polaris at an angle of elevation of 53° above the horizon.

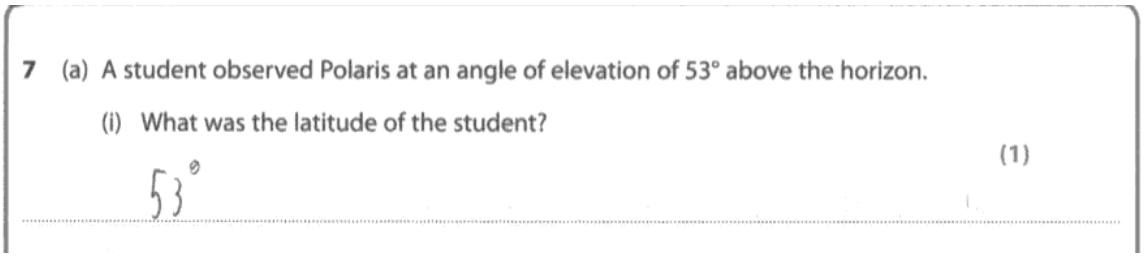
(i) What was the latitude of the student?

(1)

53°N

ResultsPlus
Examiner Comments

The candidate has correctly stated that the latitude of the observer is 53 degrees and has indicated north (1/1).


7 (a) A student observed Polaris at an angle of elevation of 53° above the horizon.

(i) What was the latitude of the student?

(1)

53°

ResultsPlus
Examiner Comments

This response does not indicate northern hemisphere and scores 0/1.

Question 7 (a) (ii)

Most candidates correctly gave 48 degrees as the elevation of Polaris from the new latitude.

Question 7 (b)

The examiners were expecting that most candidates might have first-hand experience of this. Incorrect responses referred to watching a particular star and timing how long it took to return to the same spot, clearly not a use of long-exposure photography. Some candidates suggested that the camera shutter was left open for 24 hours, a practice that would not reveal star trails.

(b) With the aid of a diagram, explain how measurements using long exposure photographs of circumpolar stars can be used to determine the rotation period of the Earth.

(3)

because as the Earth rotates the stars apear to move. And if we know the angle of change and the time of exposure we can work out the rotation period of Earth.

(Total for Question 7 = 5 marks)

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Examiner Comments

This response shows a nice sketch of Polaris and some star trails; it includes reference to the angle and exposure time and scores 3/3.

ResultsPlus
Examiner Tip

Read every word of the question carefully. This clearly states the use of long-exposure photography and so your response must refer to this.

(b) With the aid of a diagram, explain how measurements using long exposure photographs of circumpolar stars can be used to determine the rotation period of the Earth.

(3)

If you take a photograph of a star, like star A then you just get one point of where it was. Long exposure is when you let the light filter in for longer. However long the exposure is left on ~~and~~ for the star to do a complete rotation. That is the rotational period of Earth

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Examiner Comments

This suggestion is simply not possible and the candidate does not appear to understand the correct technique (0/3).

Question 8 (a)

There were some convincing descriptions involving going to a comet, collecting some ice and comparing its content with water on Earth. A few candidates misinterpreted the question and suggested making models and dropping them on a model of the Earth to see if the comet might contain enough water.

8 *(a) One possible origin of water on Earth is from the impact of comets.

Describe how astronomers can test this experimentally.

(4)

By sending probes to examine comets, astronomers can measure how much water is in the comets. They can use this to determine approximately how many comet must have hit earth to give us all our water, and the date when how long this would take. If it would take longer than the first living creature on earth to evolved, this would not have been the sole origin. They could also examine craters on Earth to see if any

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Examiner Comments

The candidate begins well by sending a probe to a comet. However, from this point onwards the response goes off on a tangent and does not suggest comparing the content of the comet's water with that on Earth. The QWC seems fine and so 2/4 marks were awarded.

8 *(a) One possible origin of water on Earth is from the impact of comets.

Describe how astronomers can test this experimentally.

(4)

Probes such as the Rosetta probe have been sent to comets. There they have taken samples of the water-ice from the comets and have analysed the chemical isotopes. From this it is possible to compare the chemical isotopes in this water to the water on Earth to see if they match. If they do, then this suggests that our water could have originated from comets impacts.

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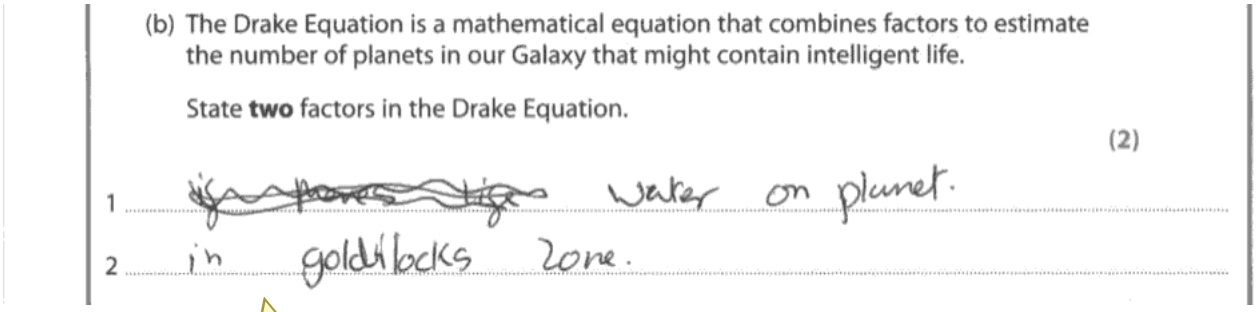
Examiner Comments

An excellent response, clearly written, and worthy of 4/4.

Question 8 (b)

There were some pleasing responses to this item, but many candidates suggested factors that were not mathematical and which could not be inserted into an equation.



(b) The Drake Equation is a mathematical equation that combines factors to estimate the number of planets in our Galaxy that might contain intelligent life.

State **two** factors in the Drake Equation.

(2)

1 ~~if ... high~~ water on planet.

2 in goldilocks zone.

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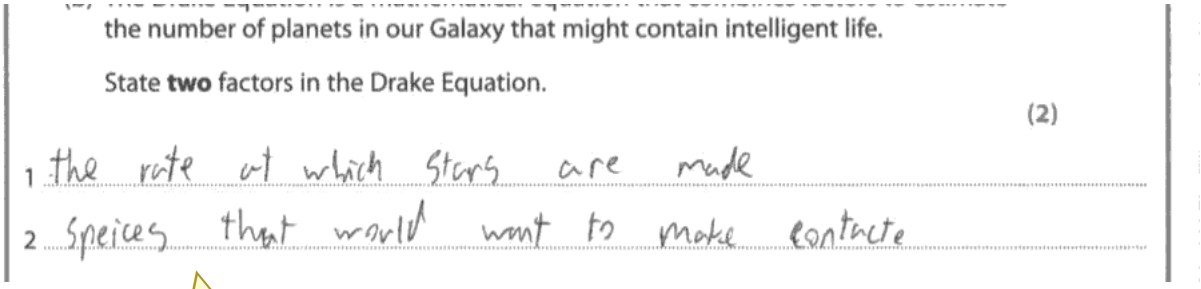
Examiner Comments

The candidate clearly has an idea of some of the factors for life, but has not written anything that could be numerical (0/2).

ResultsPlus
Examiner Tip

Read the stem of the question very carefully. The wording strongly hints that mathematical values (such as numbers, fractions or probabilities) feature in the equation.



the number of planets in our Galaxy that might contain intelligent life.

State **two** factors in the Drake Equation.

(2)

1 the rate at which stars are made

2 Speices that world want to make contacte

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Examiner Comments

The candidate scores the first mark here, but his or her second point is not mathematical and could not be inserted into an equation (1/2).

Question 9 (a) (i)

The majority of candidates correctly gave the length of the solar cycle as 11 years.

Question 9 (a) (ii)

This proved quite difficult for most candidates who failed to realise that the solar maximum occurred roughly half-way through the cycle.

Question 9 (a) (iii)

The majority of candidates gave the correct latitude.

Question 9 (b) (i)

(b) The solar wind is responsible for the appearance of aurorae on Earth.

(i) Name **one** type of charged particle contained in the solar wind.

(1)

Helium

ResultsPlus
Examiner Comments

It is clear that the question asks for a type of particle and not an element (0/1).

ResultsPlus
Examiner Tip

Read every word of the question carefully. You should appreciate the difference between elements and particles.

(b) The solar wind is responsible for the appearance of aurorae on Earth.

(i) Name **one** type of charged particle contained in the solar wind.

(1)

electron.

ResultsPlus
Examiner Comments

The electron is just one of many types of particle (proton, alpha-particle, hydrogen nucleus, ion etc.) in the solar wind and this response scores 1/1.

Question 9 (b) (ii)

There were some pleasing attempts at explaining the aurorae in terms of charged particles exciting atoms or molecules in the atmosphere that emit light when they consequently de-excite. Some candidates strayed off-course slightly by describing electrons spiralling around magnetic field lines.

(ii) Explain briefly how the solar wind causes aurorae.

(2)

The particles hit the magnetic field surrounding the earth and react with the chemicles causing the aurorae

(Total for Question 9 = 6 marks)

ResultsPlus
Examiner Comments

This response mentions some type of reaction or interaction with the atmosphere but does not refer to the emission of light (1/2).

(ii) Explain briefly how the solar wind causes aurorae.

(2)

The solar wind is funnelled by the van allen belts in the magnetosphere towards the poles. The charged particles in the wind excite gaseous molecules in the air, causing Aurorae.

(Total for Question 9 = 6 marks)

ResultsPlus
Examiner Comments

Again, this response starts well and even refers to the excitation of molecules in the atmosphere. It then fails to include the emission of light (as the molecules de-excite), scoring 1/2.

Question 10 (a) (i)

Question 10 was generally answered well. Only a handful of candidates labelled O or C on the Earth's orbit instead of Mars' orbit.

Question 10 (b) (i)

The calculation was generally performed well and the majority of candidates included the unit (years) as required.

Question 11 (a)

The examiners were very pleased with many of the responses to this question that asked candidates to use tabular information to answer its five parts. In addition, only a few candidates failed to give the Greek letters of the stars in 11(b) and 11(c).

Question 12 (a) (i)

There were many candidates who scored 3/3 for this item and the examiners were pleased that the two types of tail were correctly identified.

12 (a) Figure 7 shows a sketch of a typical long-period comet with its nucleus labelled.

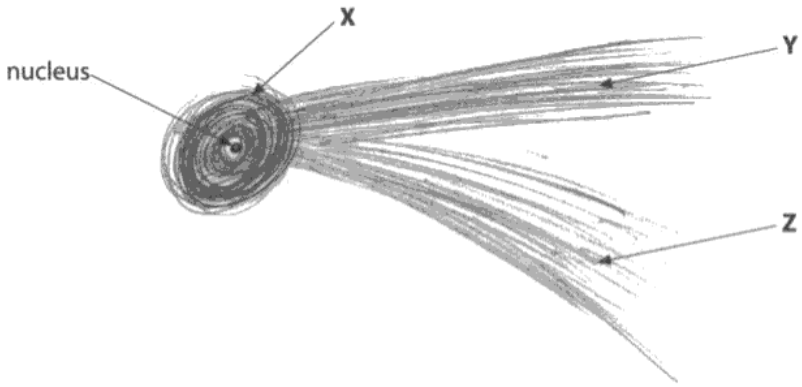

Figure 7

(i) Name the parts of the comet labelled **X**, **Y** and **Z**.

(3)

X Coma

Y tail

Z ion tail

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Examiner Comments

This candidate seems to know the structure of the comet but has not labelled the tails correctly and scores just 1/3.

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Examiner Tip

Comets have a high profile in the specification and so make sure that you know their constituent parts and how the tails are formed.

12 (a) Figure 7 shows a sketch of a typical long-period comet with its nucleus labelled.

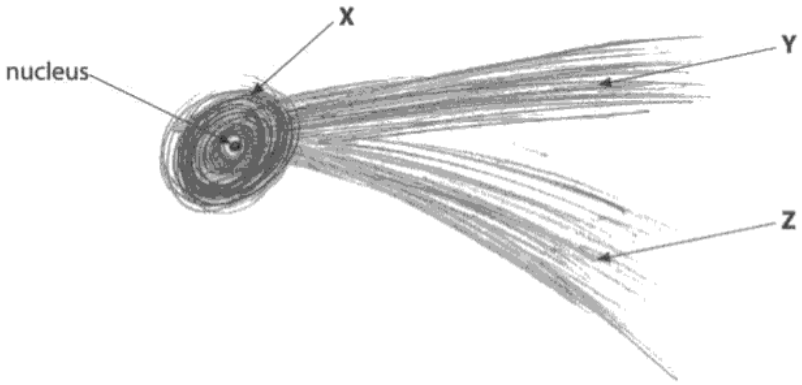

Figure 7

(i) Name the parts of the comet labelled **X**, **Y** and **Z**.

(3)

X shell

Y dust tail

Z iron tail

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Examiner Comments

This candidate seems familiar with the comet's structure, but has incorrectly labelled the coma as the shell, confused the two different tails and therefore scores 0/3.

Question 12 (a) (ii)

The likely origin of long-period comets within the Oort Cloud was known by many candidates and the examiners were pleased that the Kuiper Belt did not feature in too many responses.

Question 12 (a) (iii)

The examiners were disappointed with many responses that referred to gravity or 'pointing away from the Sun'.

(iii) Why is the feature labelled **Z** slightly curved?

(1)

Curves due to ions from solar wind.

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Examiner Comments

This response does not explain the curved nature of the dust tail and scores 0/1.

(iii) Why is the feature labelled **Z** slightly curved?

(1)

Because all the water and ice that is contained in Z is being pulled down by the force of the comet.

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Examiner Comments

An incorrect response involving gravity that was too common (0/1).

Question 12 (b)

Many candidates correctly applied the inverse square law, but a significant number incorrectly multiplied the 1.2 AU by 16 instead of by 4.

Question 13 (a)

Most candidates indicated that they were familiar with some of the ALSEP experiments and gave pleasing answers. However, a significant number gave vague or incomplete purposes such as 'to look for water' or 'to collect rocks for analysis'.

State the specific purposes of **two** instruments in the ALSEP.

(2)

1 to determine the exact distance from the moon to earth.

2 to test the rock from the moon.

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Examiner Comments

The second purpose is correct, but the candidate does not realise that rocks were returned to Earth for analysis and so not included in the ALSEP (1/2).

State the specific purposes of **two** instruments in the ALSEP.

(2)

1 Look for traces of water

2 See what the moon was made out of.

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Examiner Comments

This response is too vague to score marks (0/2).

ResultsPlus
Examiner Tip

Make sure that your answers are convincing; show the examiners that you know what you are writing about.

Question 13 (b)

Most candidates correctly labelled the Sea of Tranquility with only a few missing the spot.

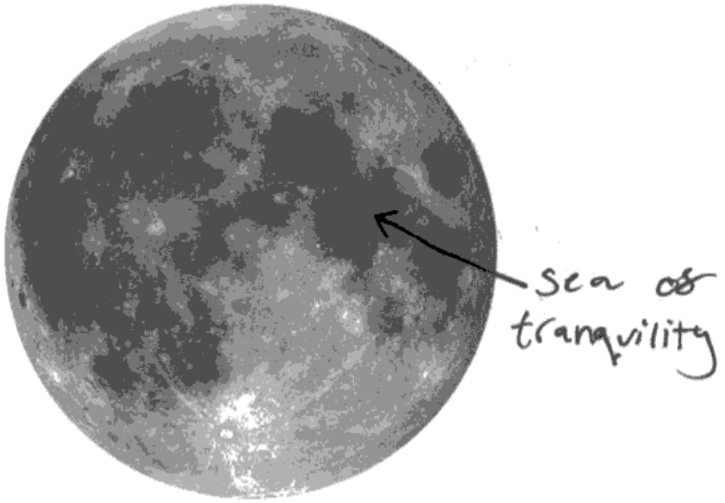


Figure 9

On Figure 9, use an arrow to show the location of the Sea of Tranquility.

(1)

ResultsPlus
Examiner Comments

The Sea of Tranquility is correctly identified and this response scores 1/1.

ResultsPlus
Examiner Tip

Make sure that you know the names of all the lunar features listed in the specification. One emphasis of GCSE Astronomy is practical observing, so try to make sure that you go out and observe the full Moon and name its principal features.

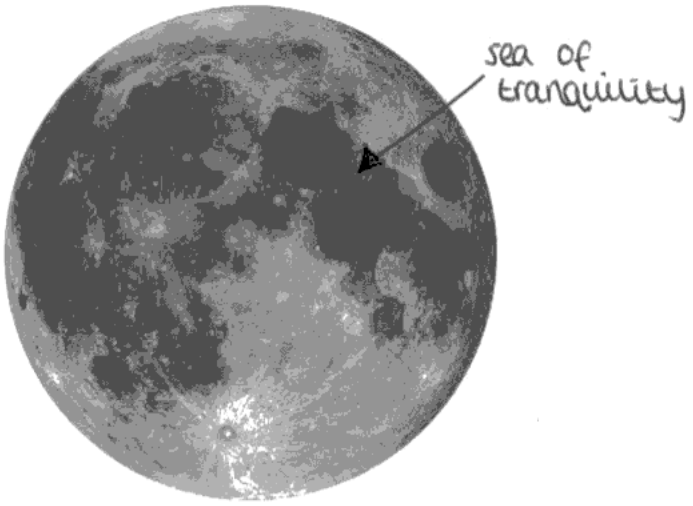


Figure 9

On Figure 9, use an arrow to show the location of the Sea of Tranquility.

(1)

ResultsPlus
Examiner Comments

This candidate has labelled the boundary between the Seas of Tranquility and Serenity (suggesting that he or she is unsure of which is which), scoring 0/1.

Question 13 (c)

The examiners were pleased with the high standard of responses that involved a Mars-sized object impacting onto a young Earth.

*(c) The Giant Impact Hypothesis can explain the origin of the Moon.
Describe briefly the Giant Impact Hypothesis.

(3)

A Mars sized ~~pla~~ celestial body collided with the early Earth creating a huge debris disc around the Earth. This debris then formed the moon due to the forces ~~of~~ of gravity. During the collision the Earth gained a lot of mass from the collision.

ResultsPlus
Examiner Comments

It is pleasing to see capital letters and full stops in this well written description of the Giant Impact Hypothesis, scoring 3/3.

*(c) The Giant Impact Hypothesis can explain the origin of the Moon.
Describe briefly the Giant Impact Hypothesis.

(3)

the great impact Hypothesis is when the Earth cdided with another planet. This left material surrounding the new Earth. The gravitational pull of the Earth rotation caused the material to ~~a~~ join together to create the moon.

ResultsPlus
Examiner Comments

The description convinced the examiners to award 2 marks for the astronomical content but 2 punctuation errors caused the QWC mark not to be given (2/3).

ResultsPlus
Examiner Tip

Make sure that you use capital letters at the start of sentences and full stops at the end, especially in those questions where QWC marks are awarded. Also ensure that proper nouns like Mars, Earth, Moon etc. are capitalised.

Question 14 (a) (ii)

There were some very pleasing completions of the Hubble tuning fork diagram, with relatively few candidates failing to pay attention to the required capital letters (e.g. SBb).

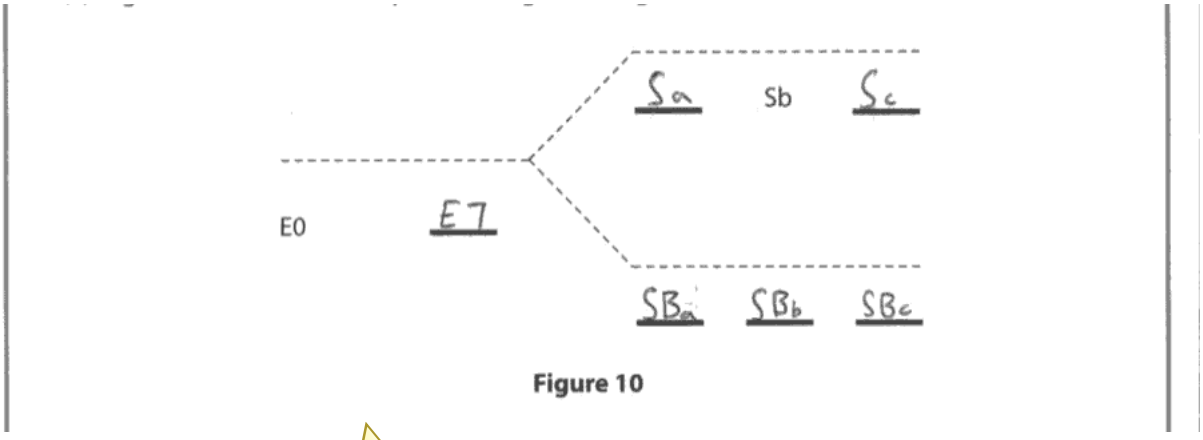


Figure 10

ResultsPlus
Examiner Comments

A perfect response, scoring 3/3.

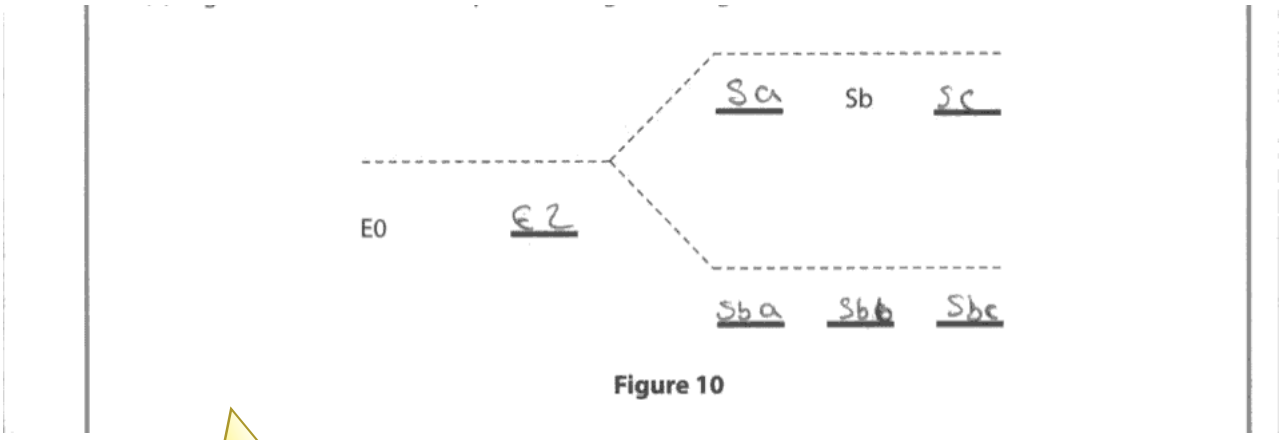


Figure 10

ResultsPlus
Examiner Comments

This candidate's E-number is too small; the line is shown clearly towards the end of the elliptical branch. The spiral prong of the tuning fork is labelled correctly but the barred spirals should be labelled SBa etc. and not Sba. A score of 1/3 could so easily have been 3/3.

ResultsPlus
Examiner Tip

Make sure that you use capital letters accordingly when labelling the different types of galaxy.

Question 14 (a) (iii)

Most candidates correctly stated either lenticular or irregular galaxies, with only a few incorrectly mentioning 'quasars' or 'clusters'.

Question 14 (b) (i)

SB or 'barred spiral' were popular correct answers, but the examiners did not accept 'spiral bar' or even 'spiral barred', requiring candidates to give the correct wording.

State the type of galaxy shown in:

(i) Figure 11

(1)

barred spiral

ResultsPlus
Examiner Comments

A correct response, scoring 1/1.

State the type of galaxy shown in:

(i) Figure 11

(1)

Spiral barred

ResultsPlus
Examiner Comments

The examiners were strict when marking correct and incorrect terminology, and this response was deemed incorrect (0/1).

Question 14 (b) (ii)

The examiners were keen to see correctly spelt responses and they were not in the main disappointed.

(ii) Figure 12. (1)

elliptical

ResultsPlus
Examiner Comments

A correctly spelt response worthy of 1/1 marks. The examiners were less lenient with responses such as 'ecliptical'.

(ii) Figure 12. (1)

E2

ResultsPlus
Examiner Comments

The examiners were equally convinced by an abbreviated response (1/1).

Question 15 (a)

The vast majority of candidates correctly interpreted the chart and identified ultra-violet and visible/IR/radio waves as correct responses to i and ii.

Question 15 (b)

The examiners were rather surprised that, with all the topical discussion on global warming etc., many candidates were not aware that UV radiation was absorbed by ozone (oxygen) and infra-red by carbon dioxide (or water vapour or methane).

Question 15 (c)

There was a variety of responses to this item; many candidates clearly knew how the Van Allen Belts were discovered, but there was evidence of guesswork on the part of others.

(c) Beyond the Earth's atmosphere lie the Van Allen Belts.
Describe briefly how the Van Allen Belts were discovered.

(2)

The Van Allen belts were discovered when the astronomer had found that objects in space such as asteroids and planets traveled along these lines in the night sky

ResultsPlus
Examiner Comments

This candidate clearly has little idea and the response is not worthy of credit (0/2).

ResultsPlus
Examiner Tip

Make sure that you study and revise all the topics in the specification; this will ensure that you have access to maximum marks.

(c) Beyond the Earth's atmosphere lie the Van Allen Belts.
Describe briefly how the Van Allen Belts were discovered.

(2)

interference with spaceprobes' readings around earth.

ResultsPlus
Examiner Comments

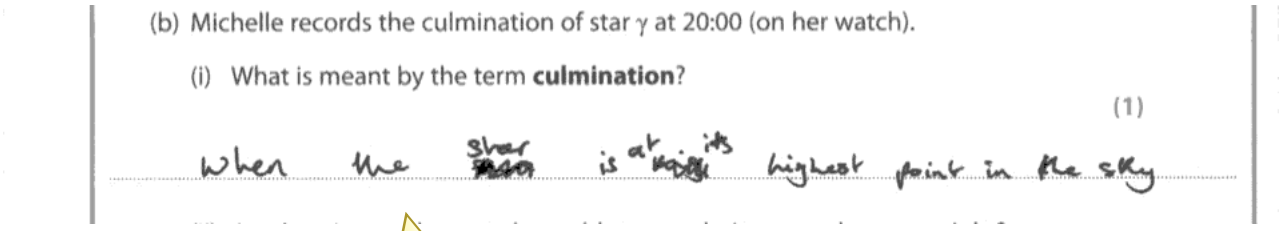
The mention of space probes in an otherwise disappointing response scores 1/2 marks.

Question 16 (a)

The examiners were pleased with the manner in which candidates studied and interpreted the table of data. Most could show their awareness that epsilon was both highest in the sky and the furthest west.

Question 16 (b) (i)

The examiners were very pleased that most candidates could describe what was meant by the term culmination.


(b) Michelle records the culmination of star γ at 20:00 (on her watch).

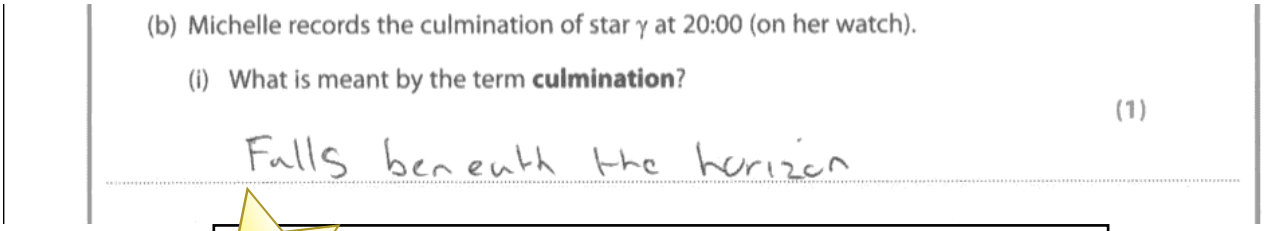
(i) What is meant by the term **culmination**?

(1)

when the star is at its highest point in the sky

ResultsPlus
Examiner Comments

This correct response scores 1/1.


(b) Michelle records the culmination of star γ at 20:00 (on her watch).

(i) What is meant by the term **culmination**?

(1)

Falls beneath the horizon

ResultsPlus
Examiner Comments

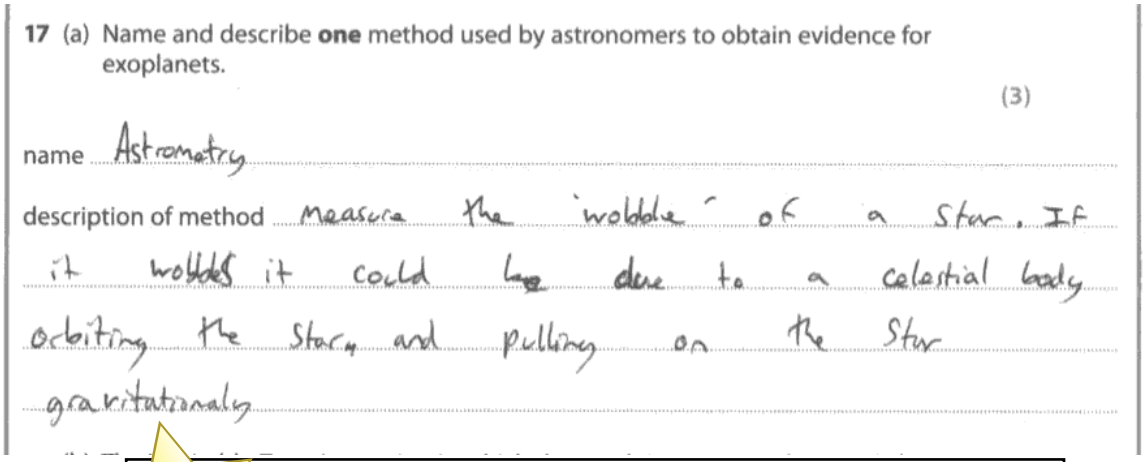
This response is incorrect and the candidate has failed to mention crossing the observer's meridian, being due south or highest in the sky (0/1).

Question 16 (b) (ii)-(iii)

This proved difficult for many candidates who attempted to calculate times of culmination.

Question 17 (a)

There were some correct descriptions of methods used by astronomers to detect the presence of exoplanets, but many did not gain maximum marks due to a lack of detail.



17 (a) Name and describe **one** method used by astronomers to obtain evidence for exoplanets.

(3)

name Astrometry

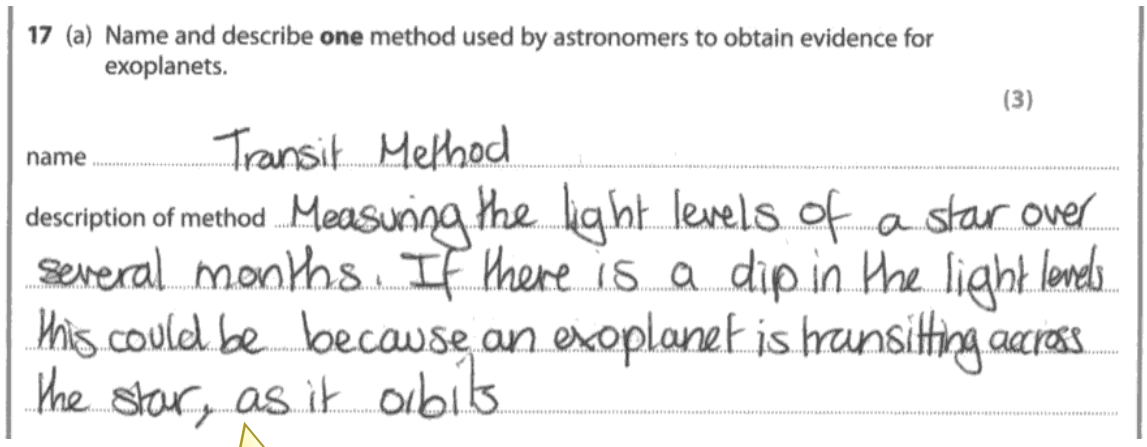
description of method measure the 'wobble' of a star. If it wobbles it could be due to a celestial body orbiting the star, and pulling on the star gravitationally

ResultsPlus
Examiner Comments

2/3 marks are scored here for naming a correct method of detecting exoplanets and briefly describing the 'wobble' in a star's position. A further point, such as the fact that such wobbles would occur at regular intervals, was needed for the third mark.

ResultsPlus
Examiner Tip

Look carefully at the number of marks awarded for each item and ensure that your number of points or statements match these.



17 (a) Name and describe **one** method used by astronomers to obtain evidence for exoplanets.

(3)

name Transit Method

description of method Measuring the light levels of a star over several months. If there is a dip in the light levels this could be because an exoplanet is transiting across the star, as it orbits

ResultsPlus
Examiner Comments

Another example of a response that just fails to gain maximum marks; only one valid piece of information is included in the description, resulting in 2/3 marks.

Question 17 (b)

The examiners were expecting a clearly-labelled diagram showing a zone of 'correct' distances from a star, or indeed the Sun, and reference to correct temperatures to support liquid water. Candidates generally scored high marks for this item.

(b) The Habitable Zone is a region in which the conditions on exoplanets might support life. With the aid of a diagram, show what is meant by a Habitable Zone and explain why astronomers expect the conditions could support life. (3)

Astronomers could suggest that since 'water' was found to once be there that it would be capable of with holding life as perhaps plantation could be grown and therefore oxygen from Photosynthesis could be grown

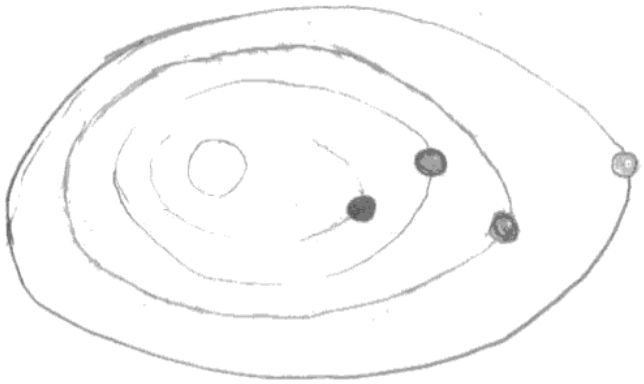
(Total for Question 17 = 6 marks)

ResultsPlus
Examiner Comments

This diagram fails to score. However, there is the brief mention of water and so 1/3 marks were awarded.

(b) The Habitable Zone is a region in which the conditions on exoplanets might support life. With the aid of a diagram, show what is meant by a Habitable Zone and explain why astronomers expect the conditions could support life.

(3)



The Goldilocks (habitable) zone goes around the earth and it has the right qualities to support human life. It is the perfect distance away from the Sun to have life and water facilities.

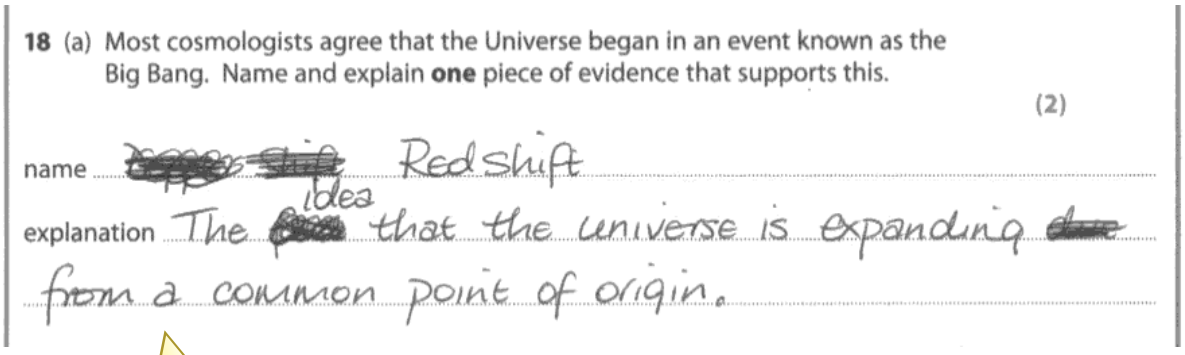
ResultsPlus

Examiner Comments

Once again, water is mentioned here, but the response does not include correct temperature ranges and the diagram does not actually point out which is the habitable Zone (1/3).

Question 18 (a)

There were some mixed responses to this item and many candidates named the expansion of the Universe and not the CMB radiation as a main piece of evidence for the Big Bang.



18 (a) Most cosmologists agree that the Universe began in an event known as the Big Bang. Name and explain **one** piece of evidence that supports this.

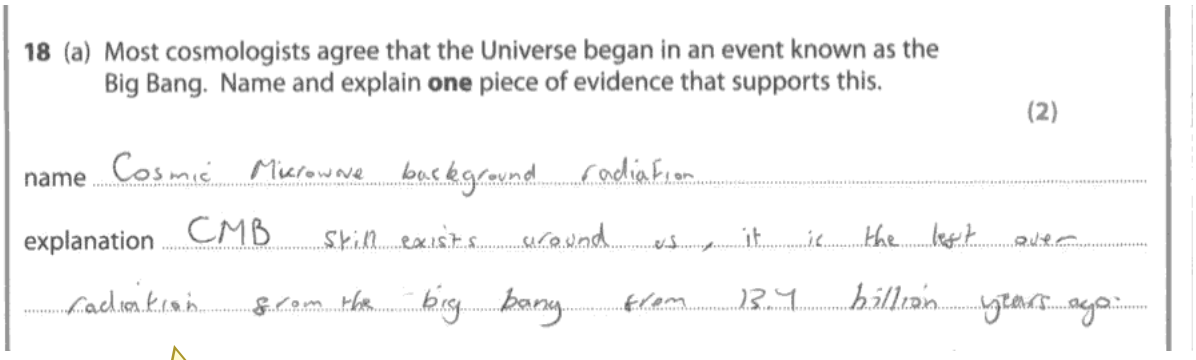
(2)

name [redacted] Redshift

explanation The idea that the universe is expanding from a common point of origin.

ResultsPlus
Examiner Comments

This typifies a common error. The expansion of the Universe is not evidence for the Big Bang, merely for an expanding Universe, and so this response gained 0/2.



18 (a) Most cosmologists agree that the Universe began in an event known as the Big Bang. Name and explain **one** piece of evidence that supports this.

(2)

name Cosmic Microwave background radiation

explanation CMB still exists around us, it is the left over radiation from the big bang from 13.7 billion years ago.

ResultsPlus
Examiner Comments

This is a perfect answer, worthy of 2/2. The CMB radiation has been named and the candidate has related this to radiation from 13.7 billion years ago.

Question 18 (b)

A mixture of responses showed that many candidates were not really aware of 'alternative' models of the Universe. Despite the wording in the question, a surprisingly large number of candidates described the future Universe.

*(b) Some cosmologists have proposed different models for the past evolution of the Universe.
Name and describe **one** of these models.

(3)

name Steady State Theory

description This states that the Universe has always been around and is is continually expanding. As matter gets further apart, new matter is created in the previous place.

ResultsPlus
Examiner Comments

This response is correct as far as the Astronomy is concerned, but the clarity of the description did not merit the QWC mark (2/3).

ResultsPlus
Examiner Tip

Where there is a QWC mark awarded, you have plenty of time to think through your answer and write it in a manner which flows logically. Do not forget those full stops and capital letters as well.

*(b) Some cosmologists have proposed different models for the past evolution of the Universe.
Name and describe **one** of these models.

(3)

name ~~Big Bang~~ Big Crunch

description This is a ~~is~~ one theory for the future of the Universe, whereby the Universe continues to expand but the ~~e~~ ~~c~~ then collapses by its own force of gravity and all the galaxies are compressed back ~~for~~ into one and other.

ResultsPlus
Examiner Comments

This response describes one possible future of the Universe, and yet the question quite clearly asks for a model of the past evolution of the Universe.

ResultsPlus
Examiner Tip

Again, read the stem carefully so that you do not misunderstand the requirements of the question.

Question 18 (c)

Responses to this question followed on in the same vein as the previous one: too many candidates described what they thought dark matter and dark energy were instead of relating them to the possible future of the Universe.

Question 19 (a)

The examiners had hoped that candidates would write about moving sources of waves and the detection of these by an observer. They had expected candidates to describe an apparent increase or decrease in wavelength or frequency or even describe the perceived changes in pitch of an ambulance siren as it passes by. However, such descriptions were rare and candidates fell into the 'trap' of describing redshift and the expansion of the Universe, and only received partial credit.

19 In the 1930s Edwin Hubble made observations of distant galaxies.
Using the Doppler principle, Hubble proposed the theory of an expanding Universe.

(a) Describe the Doppler principle.

(2)

This is where spectral wavelengths detected from galaxies are red-shifted.

ResultsPlus
Examiner Comments

A common error: the candidate has referred to redshift and failed to mention that the galaxies are moving (0/2).

19 In the 1930s Edwin Hubble made observations of distant galaxies.
Using the Doppler principle, Hubble proposed the theory of an expanding Universe.

(a) Describe the Doppler principle.

(2)

The Doppler principle is where objects that are moving away from us have stretched wavelengths that correspond to absorption lines on the stellar spectrum. Objects moving away become red-shifted and objects moving towards become blue shifted.

ResultsPlus
Examiner Comments

A first class response, describing changing wavelengths (or frequencies) detected from moving sources of waves (2/2).

Question 19 (b)

A difficult question that was answered well; most candidates were able to manipulate the formula, give the correct answer and include the correct unit.

(b) An astronomer determines the wavelength of a spectral line in the spectrum of a distant galaxy to be 680 nm. The same spectral line at rest has a wavelength of 510 nm.

Use this data to determine the recession velocity of the galaxy and give the unit. The speed of light is 300 000 km/s.

Use the formula

$$\frac{v}{c} = \frac{\lambda - \lambda_0}{\lambda_0}$$

(3)

$\frac{680 - 510}{510} = \frac{1}{3}$

velocity = 1 km/s

ResultsPlus
Examiner Comments

Although this candidate has made an error in the arithmetic, he or she has substituted the correct values into the formula and given the correct unit of km/s, scoring 2/3.

ResultsPlus
Examiner Tip

Remember to show all stages in your calculation; even if you fail to reach the final answer, you may well receive some credit for some correct stages.

(b) An astronomer determines the wavelength of a spectral line in the spectrum of a distant galaxy to be 680 nm. The same spectral line at rest has a wavelength of 510 nm.

Use this data to determine the recession velocity of the galaxy and give the unit. The speed of light is 300 000 km/s.

Use the formula

$$\frac{v}{c} = \frac{\lambda - \lambda_0}{\lambda_0}$$

(3)

680 − 510 = 170, 170 ÷ 510 = 0·3

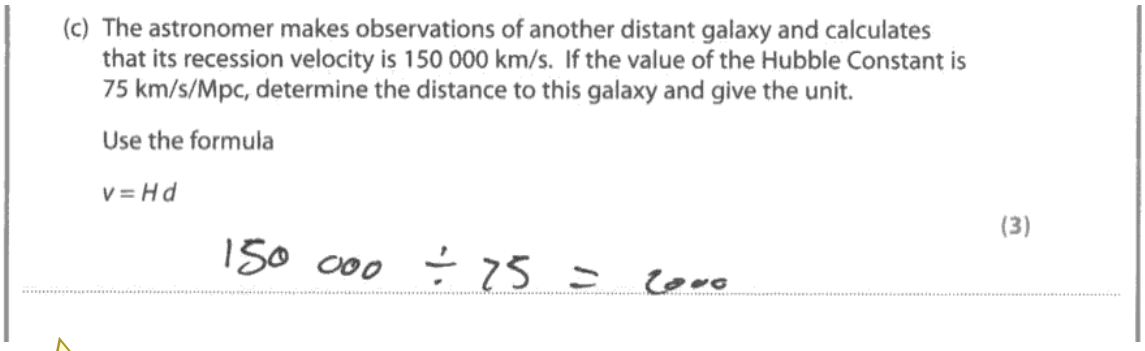
0·3 × 300 000 = 90 000

ResultsPlus
Examiner Comments

There is nothing worthy of a mark in this example: the substitutions are incorrect and there is no final unit that would have likely scored 1 mark (0/3).

Question 19 (c)

Candidates who could manipulate the somewhat difficult concept of Hubble's Law and give the correct unit of Mpc were rewarded with 3 marks, and it was pleasing that a significant number of candidates performed well in this item.



(c) The astronomer makes observations of another distant galaxy and calculates that its recession velocity is 150 000 km/s. If the value of the Hubble Constant is 75 km/s/Mpc, determine the distance to this galaxy and give the unit.

Use the formula

$v = Hd$

(3)

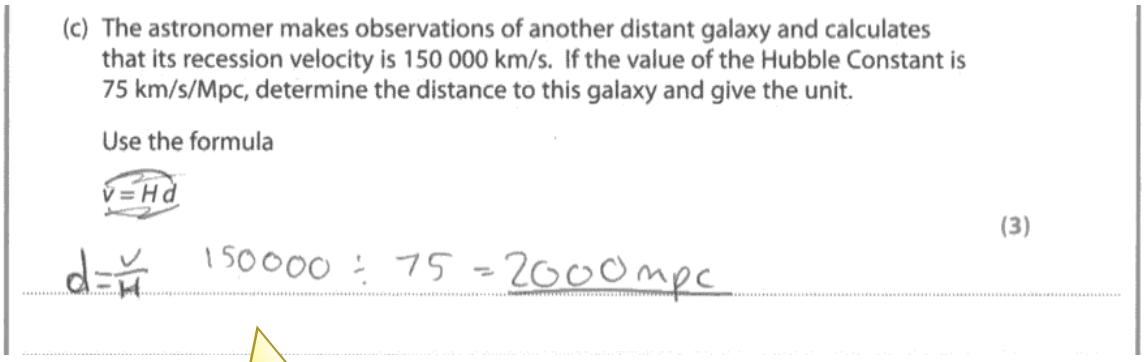
150 000 ÷ 75 = 2000

ResultsPlus
Examiner Comments

By omitting the unit, this candidate has scored just 2/3.

ResultsPlus
Examiner Tip

Remember that the unit is just as important as the number.



(c) The astronomer makes observations of another distant galaxy and calculates that its recession velocity is 150 000 km/s. If the value of the Hubble Constant is 75 km/s/Mpc, determine the distance to this galaxy and give the unit.

Use the formula

$v = Hd$

(3)

$d = \frac{v}{H}$ 150000 ÷ 75 = 2000mpc

ResultsPlus
Examiner Comments

A mistake of writing mpc instead of Mpc has cost this candidate 1 mark (2/3 scored).

Question 20 (a) (i)

This item tested the candidates' abilities to understand the concept of absolute magnitude and there were some pleasing responses from most candidates.

Question 20 (b)

This was a challenging question at the end of the examination paper, requiring thought rather than formal calculation (note the lack of a formula that is not required, although some candidates did use the distance modulus formula to good effect). Its solution involves using the inverse square law and relating the brightness ratio of 16 to 3 magnitudes difference. A relatively small number of candidates correctly used this method to reach an apparent magnitude of 2.7.

(b) Two stars, α and δ, have the same absolute magnitude, but star δ is 4 times further away than α. If the apparent magnitude of α is –0.3, deduce the apparent magnitude of δ.

(3)

$4 = \frac{1}{16}$

$0.3 \times 16 = 4.8$

(Total for Question 20 = 5 marks)

ResultsPlus
Examiner Comments

The candidate has shown us that he or she understands the inverse square law concept and reduced the apparent brightness by 16. However, the candidate has not related this to 3 magnitudes difference and so gains just 1/3.

(b) Two stars, α and δ, have the same absolute magnitude, but star δ is 4 times further away than α. If the apparent magnitude of α is –0.3, deduce the apparent magnitude of δ.

(3)

$\frac{1}{4^2} = \frac{1}{16}$

a appears 16 times brighter

$2.5\sqrt{16} = 3.031433133$

$3.031433133 - 0.3 = 2.731433133$

$m = 2.73$

(Total for Question 20 = 5 marks)

ResultsPlus
Examiner Comments

Although the working is sometimes difficult to follow, the candidate has taken the right steps to determine the magnitude of 2.7 and scores a deserved 3/3.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Candidates should read all questions carefully in order to ensure that they understand fully what is being asked. It is important to distinguish between commands such as, 'How' and 'Why', and 'State', 'Describe' and 'Explain'
- Candidates should note the number of marks available for each item; if 2 marks are available, then there should be 2 individual and distinct points made
- Candidates should also bear in mind their quality of written communication, particularly in those part-questions that indicate where a mark is to be awarded for their ability to communicate effectively; certainly, they should be aware of proper nouns such as Sun, Mars, Earth, Moon etc. that require capitalisation
- In calculations, candidates should show all their working and make their final answer clear; they should pay particular attention to the unit (or lack of) and give a sensible number of significant figures
- Candidates should ask themselves: 'Is my answer sensible?', as this might avoid a value such as 2000 km being given as the answer to item 19c requiring calculation of the distance to a distant galaxy
- There are two hours allocated to this paper, which is sufficient time for candidates to pause and consider their answers before putting pen to paper, and for them to re-read and review their answers at the end.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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